National Aeronautics and
Space Administration

EXPLORE MARS

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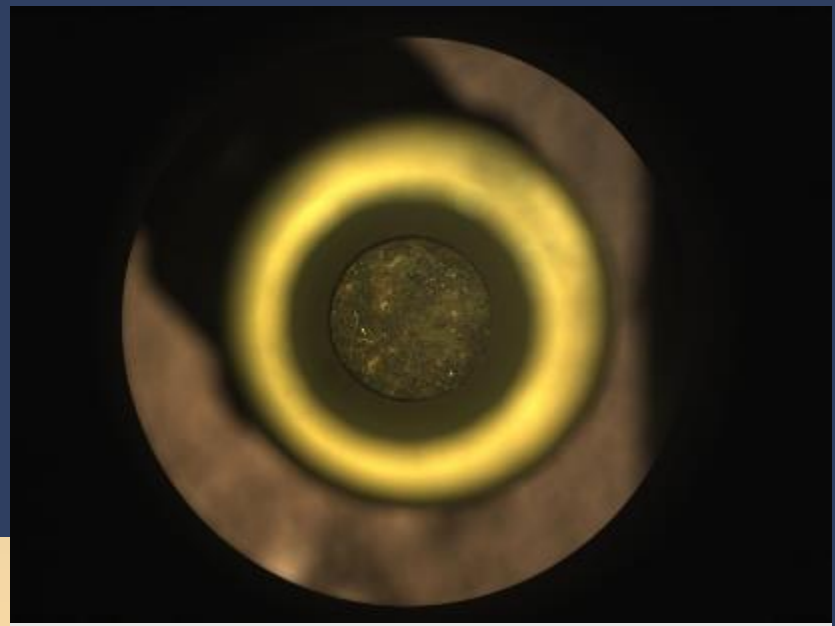
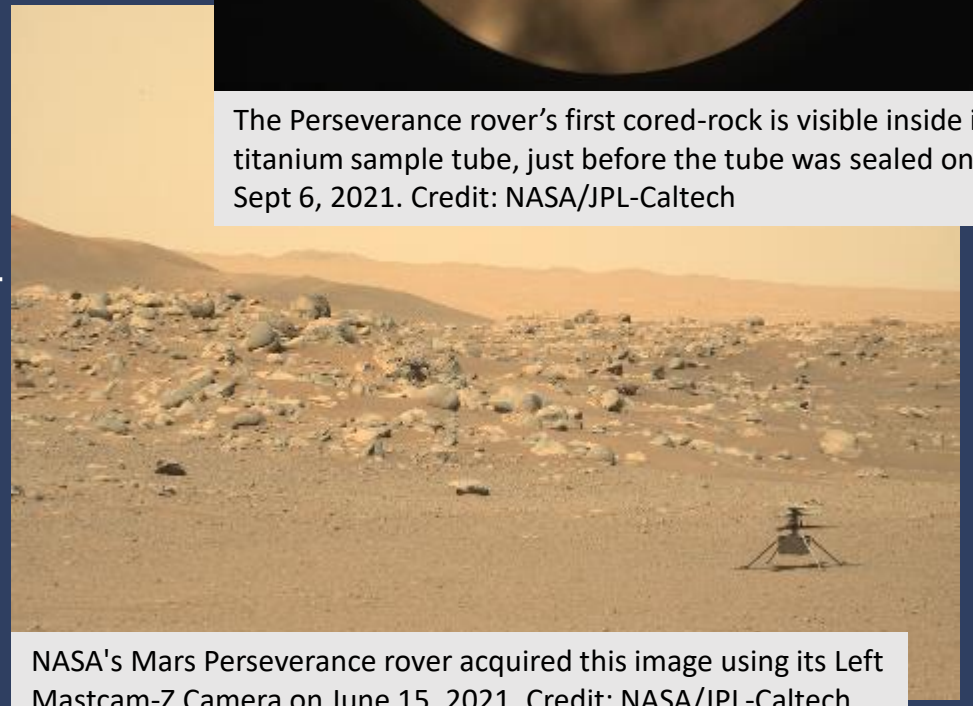
Mars Exploration Program Presentation to MEPAG
September 27, 2021

Mars Exploration Status Highlights

- Perseverance successfully acquired a pair of sample cores from “Rochette”
- Ingenuity helicopter operations demonstrations phase successfully completed 13 flights
- Abundance of applications received for International Mars Ice Mapper Measurement Definition Team (MDT)
- Mars Science Laboratory (MSL) Participating Scientist proposals due: Step-1 Sept 15, 2021 Step-2 Nov 5, 2021
- Mars missions in Solar Conjunction ~ Sept 27, 2021 thru Oct 20, 2021
- Special Topics Briefings on Insight, MSL Curiosity & Perseverance follow



The Perseverance rover’s first cored-rock is visible inside its titanium sample tube, just before the tube was sealed on Sept 6, 2021. Credit: NASA/JPL-Caltech



NASA's Mars Perseverance rover acquired this image using its Left Mastcam-Z Camera on June 15, 2021. Credit: NASA/JPL-Caltech

Perseverance Sampling

Coring Sample: After making the first sample acquisition using a multi-sol plan with ground-in-the-loop sequences of imaging to confirm core in tube, the second sample acquisition operation from drilling through sealing/storing process was conducted in a single sol plan.

- After collecting its first sample, named “Montdenier,” Sept 6, 2021, the team collected a second, “Montagnac,” from the same rock Sept 8, 2021
- Next sample attempt after solar conjunction

This Mastcam-Z image shows a sample of Mars rock inside the sample tube on Sept 1, 2021, shortly after the coring operation. NASA/JPL-Caltech

MEP HQ Staffing Updates

Tiffany Morgan - Mars Exploration Program Deputy Director

Before joining NASA HQ as the MEP Deputy Director, Tiffany was Project Manager for the Solar Electric Propulsion (SEP) Project at NASA's Glenn Research Center in Cleveland. She spent over a decade working for Air Force Space Command (now the Space Force) with a focus on rapid space acquisitions including spacecraft missions, satellite command & control systems and Department of Defense (DoD) payloads. Prior to civil service, Tiffany worked for the Army Space and Missile Defense Command at the Reagan Test Site in the Marshall Islands managing optics and radar systems and held positions in industry with an emphasis on process and systems engineering.

Becky McCauley Rench, Ph.D. – Mars Science Laboratory Program Scientist

Becky is a Program Scientist in the Planetary Science Division at NASA Headquarters, where she leads the Planetary Protection Research and Habitable Worlds Programs. She is the Program Scientist on New Horizons and for the Planetary Data System. She is an astrobiologist and has a history with the Curiosity mission starting with an internship at GSFC with Dr. Paul Mahaffy focused on the SAM instrument. She vividly remembers the awe-inspiring day when she watched Curiosity launch from Cape Canaveral and was on the edge of her seat in her graduate student laboratory at Penn State at 2am when the rover set down on the surface of Mars. She has served as the Deputy PS on MSL for the past 8 months under the mentorship of Michael Meyer.

Mission Updates

- InSight: Solar array power generation trends indicate that the spacecraft just passed its lowest energy period. InSight is prepared for solar conjunction
- MOMA: Instrument fully integrated with Rosalind Franklin rover. NASA providing assistance with ExoMars Rover parachute testing. Drop Test in Oregon scheduled for Fall 2021
- Ongoing NASA orbiter missions are healthy, productive, and funded through FY21
  - Odyssey: > 20 years since launch, and still going strong; “All-stellar mode” is in use to preserve Inertial Measurement Unit (IMU) lifetime
  - MRO: Full operational capability restored after likely SEU initiated spacecraft safe mode; “All-stellar mode” in use to preserve IMU lifetime
  - MAVEN: Set a new solar system record for throughput during a single communications session at another planet during a relay session with the Perseverance rover. A total of 2.34 Gbits were transferred, well exceeding the prior record of 1.74 Gbits. The use of the low-density parity check (LDPC) encoder was a significant contributor
  - ExoMars/TGO (ESA): Continues to return over 55% of the total UHF relay science data from Mars landed assets

“Malamaire” View of “Citadelle” Area: This mosaic image shows a rock outcrop in the area nicknamed "Citadelle" on the floor of Mars' Jezero Crater. “Rochette” is circled in yellow. Credits: NASA/JPL-Caltech.

“Rochette” After Perseverance Sampling: Sept 7, 2021, PDT, shows two holes where the rover's drill obtained chalk-size samples from rock nicknamed "Rochette." Credits: NASA/JPL-Caltech.

Octavia E. Butler Landing

Artuby Ridge

Citadelle

Roubion

200 METERS

Perseverance Mars Journey & “Rochette”

This image shows the **journey of NASA's Perseverance** rover across Jezero Crater since landing on Feb 18, 2021. From "Octavia E. Butler Landing," the rover drove south and attempted to collect at "Roubion" in early August. Perseverance drove northwest along "Artuby" ridge to an area known as "Citadelle," where it successfully collected its first two samples in early September. The first core was taken from "Rochette," at the drill hole "Montdenier." A paired sample of Montdenier was taken at the drill hole "Montagnac." "Séítah," a future area of rover exploration. Credits: NASA/JPL-Caltech.

Ingenuity Helicopter

Ingenuity operations to date:
Number of flights: 13
Total flight time: 24.5 minutes
Total flight distance: 9452 ft (2881 m)
Maximum Altitude: 39 ft (12 m)
Navcam Images Returned: 1581
Color RTE Images Returned: 82

- Successfully completed the flight test program & transitioned into an operations demo phase
- Focused on providing surveys of potential scientific interest areas and inaccessible terrains for Perseverance
  - Highly capable reconnaissance platform
- Successfully completed high-speed spin rotor test to prepare for lower atmospheric density flights
- Flight operations to support rover science planned to resume after conjunction

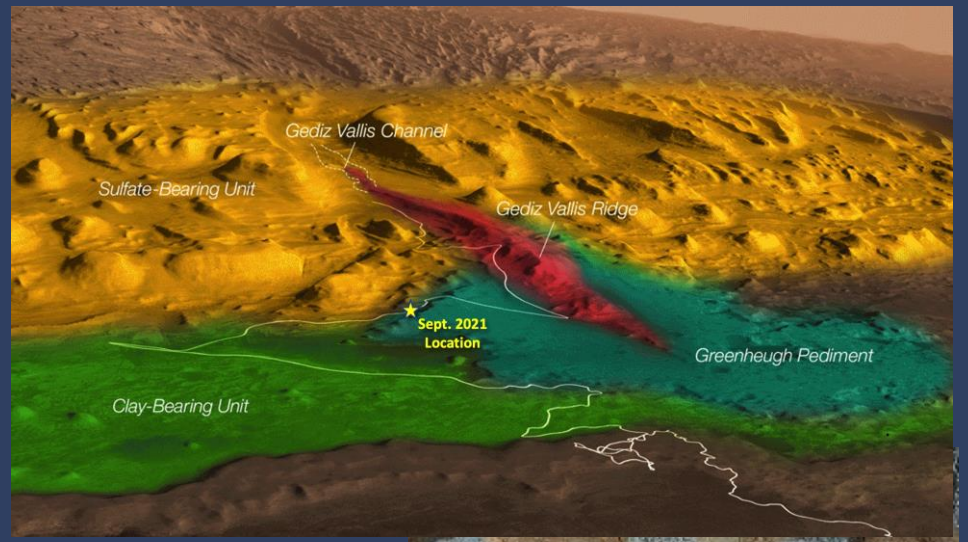
International Mars Ice Mapper (I-MIM)

- **Multilateral Concept Team Study** currently underway per the Jan 2021 Statement of Intent among NASA, CSA, ASI, and JAXA
- **Engineering Milestones**
  - Partner agencies completing I-MIM Point Design 2.0 and a preliminary, coordinated mission schedule
  - Concept Study benchmarks are leading toward the potential for further international agreements and facilitating a potential future Phase A start for all
  - Netherlands Space Office is an additional active participant in the study, potentially contributing flexible solar arrays
- **Reconnaissance*/Science Measurement Definition Team (MDT) Status**
  - Targets high-priority science measurements for human exploration: human-led *in situ* science investigations (e.g., accessing the ice, potentially through ice coring) and water-ice resources for sustainable human exploration (propellant etc.)
  - Successful call for international, multidisciplinary applicants during Jul/Aug, 2021
  - Concept Team in the process of reviewing/selecting members (likely announcement by early Oct 2021)

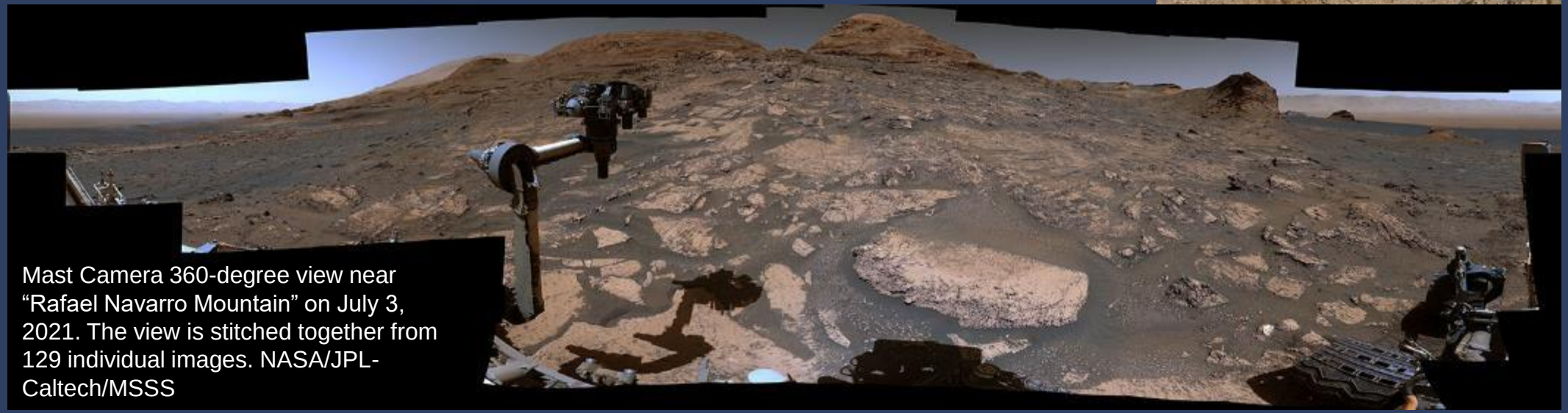
*Reconnaissance: "What we need to know before humans go"

Mars Science Laboratory

- Curiosity continues its climb up Mt Sharp near Rafael Navarro Mountain - moving out of the clay unit and towards the sulfate unit
- Curiosity has used the drill on its robotic arm to take 33 rock samples to date
- Mast Camera captured the below panoramic view of a craggy hump that reaches 450 feet tall located on Mt Sharp in northwest Gale Crater



Mars Hand Lens Imager (MAHLI), a camera on the end of the robotic arm, provided the images in this collage



Mast Camera 360-degree view near “Rafael Navarro Mountain” on July 3, 2021. The view is stitched together from 129 individual images. NASA/JPL-Caltech/MSSS

Mars Sample Return (MSR) Updates

- Program is in Phase A, maturing technical/programmatic baseline for KDP-B
- Staffed key leadership roles across program
- Making progress on multiple technology and engineering developments including orbiting sample sealing technique, MAV thrust vector control, and Earth Entry System impact structure
- Initiated numerous procurement efforts
  - ESA Earth Return Orbiter (ERO) now in Phase B2/C/D
  - Sample Retrieval Lander (SRL) Aeroshell, Landing Engines, etc
  - Capture, Containment and Return System (CCRS) Spin Eject Mechanism Request for Proposal (RFP) released
  - Earth Entry System (EES) Aeroshell study contract to be released by October
  - Mars Ascent Vehicle (MAV) System Integration RFP released

Science Updates

- MSR Science Planning Group-2 report completed and submitted for publication; joint MSR Operational Scenarios Definition Team ongoing; Receiving Facility trade studies planned for FY22
- InSight
  - Studies published in July that utilize analysis of seismic data collected by InSight, conclude the estimated of the size of Mars's core, the thickness of its crust, and the composition of its mantle
  - On August 26th, InSight measured 2 exceptional new Marsquakes, likely the 2 largest Marsquakes InSight Seismic Experiment for Interior Structure (SEIS) has measured so far
- Moon to Mars Ice and Prospecting Challenge – Sept. 23-25: Engineering design and technology demonstration contest for eligible undergraduate and graduate students.
- Decadal Survey Recommendations at Lunar Planetary Science Conference (LPSC) in March 2022
- Mars Data Analysis Program
  - Mars Data Analysis Program: selected 31 of 96 Step-2 proposals
  - FINESST proposals selected: 4 for Mars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